













































AD-A119 090 NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY NSTL 8--ETC F/8 8/10
DOCUMENTATION OF SOFTWARE FOR ESTIMATING EXPENDABLE SHEAR PROF--ETC(U)
JUN 82 K D SAUNDERS
UNCLASSIFIED NORDA-50 NL

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Information regarding the progress of the
work in order to secure this material
early to the staff of the Department.

The report should be submitted to the
Director of the Bureau of Intelligence
and Information Services.

U. S. DEPARTMENT OF
STATE
BUREAU OF INTELLIGENCE
AND INFORMATION SERVICES

Executive Summary

Expendable Current Profilers (XCPs) do not transmit a pressure signal from the instrument to the ship. The depth is determined either by an empirical equation or by comparison with a reference oceanic variable. This report provides documentation of a computer program for the determination of a least squares best fitted polynomial for determining the depth as a function of time, using temperature as measured from a CTD at the time of the profiler drop.

Acknowledgments

This work was supported by NORDA Code 500, Dr. Rudolph Hollman project manager.

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Documentation of Software for Estimating Expendable Shear Profiler (XCP) Fall Rates

I. Introduction

A serious problem encountered when analyzing XCP (Expendable Current Profiler) data is the error in true depth of the instrument. The XCP is free falling and does not transmit a pressure signal to the ship. Because there is no direct measurement of pressure, the pressure is estimated through the use of an empirical equation relating time (starting when the profiler is dropped) to pressure. Variations in launching procedures, initial conditions and oceanic conditions may result in significant departures of the true pressure from that estimated by the equation.

The XCP does return a temperature signal to the ship. If the true temperature profile (versus pressure) is known, then it should be possible to obtain an accurate estimate of the position of the instrument as a function of time through appropriate comparison of the true profile of temperature and that returned by the XCP.

A program to accomplish this has been written and is documented in this report. The theory and some particular results are given in the journal (Oceans, September 1981) reprint in the following section; the detailed program documentation follows.

II. Reprint from Oceans, September 1981

A.W. Green and K.D. Saunders

Naval Ocean Research & Development Activity, NSTL Station, MS 39529

ABSTRACT

Recent intercomparisons of depths of expendable bathythermographs (XBT) and electromagnetic current profilers with more accurate shipboard profilers have shown that the empirical formulae currently used are in error. A theoretical model for the bulk dynamics of XBT's (T-7) and XCP's is proposed and assessed with recent intercomparisons between XCP's with accurate Conductivity-Temperature-Depth profilers (CTD's). The records for the intercomparisons were obtained in the Gulf of Mexico, where a rich temperature fine-structure provides numerous features in the profiles that quantitatively improve the XBT/CTD and XCP/CTD comparisons. The theory yields fall rate and total depth versus time predictions that agree with observations somewhat better than the manufacturer's empirical formulae. The theory also furnishes a rational basis for establishing deployment techniques and probe modifications that can improve depth accuracy and fall rate.

1. INTRODUCTION

During the past decade the production technology for expendable oceanographic profiling instruments has improved significantly, consequently, expendables are becoming increasingly important in oceanographic survey work. As the measurement consistency of these devices has improved, the users have increased their demands of quality of the data obtained by the probes. Probe fall rate and depth as a function of time have received relatively little attention in technical literature to date. The expendable probes such as XBT's (bathythermographs), XCP's (Current plus BT), XSV's (Sound speed + BT) are not currently equipped with pressure sensors; thus, the probe depth must be estimated from empirical formulas based on observed fall rates and depths as a function of time. These empirical formulas do not in general provide the best possible estimates of probe fall rate or depth. Motivated by our own needs to improve probe fall rate and depth estimates, we have undertaken development of experimental methods and theories that will help reduce fall

rate and depth errors. In this paper we present results of a simple dynamical model for streamlined bodies, such as expendable profilers, falling through water. The model is applied specifically to XCP's in this paper, but we note that it is also applicable to other types of expendables (Green, 1981). Next we describe calibration methods that reduce depth error by analytical treatments of XCP data and profiles from reference instruments, such as conductivity-temperature-pressure profilers (CTD's). We show that the dynamical model is in general an excellent predictor of probe depth as a function of time. We conclude our discussion with some recommendations that could improve XCP probe performance.

2. THE DYNAMICAL MODEL

A body falling vertically through water is subject to the bulk forces of hydrodynamic drag and buoyancy, which are in balance described by the following equation:

$$M dv/dt = \frac{1}{2} \rho_w C_D S v^2 - g(M - M_w) \quad (2.1)$$

The bulk drag force is proportional to the square of the fall velocity (v), and the buoyancy is determined by the difference between the body mass and the mass of the water displaced. (A list of definitions of the symbols are in Appendix A.) The expendables currently in use operate over a range of Reynolds number (R) between 10^5 and 10^6 , where R is defined for a streamlined body as the product of probe length and fall speed divided by the kinematic viscosity of the water. The kinematic viscosity increases with depth in the ocean and the fall speed is relatively constant after initial transient adjustment, consequently, the R tends to decrease with increasing depth. If the probes were perfect streamlined bodies moving through quiescent sea water, then we should expect that the drag coefficient (C_D) would vary significantly with depth and alter the drag force. This tendency appears to be attenuated by probe rotation caused by the axial stabilizing fins, which disturb ("turbulize") the boundary layer flow over the probe and increase the wake turbulence. The net effect is that the flow regime around the probes is fully turbulent. The C_D of the probe is much less affected by variations in Re in fully turbulent flow (Hoerner, 1965), but we should

keep in mind that small changes in C_D over the range of the probe can make significant changes in fall rate.

The buoyancy of a probe also changes due to unspooling of the signal transmission wires. The mass of wire loss is partially replaced by water that is entrained within the probe. To a good approximation the mass loss rate is proportional to the depth. Under extreme operating conditions this simple assumption may be in error (Green, 1981).

Green (1981) found an approximate solution to (2.1) for the special case in which the initial probe speed is equal to the nominal fall rate [$v(z=0) = V_T$]. The mass slowly decreases and the drag coefficient slowly increases linearly with depth; for the model the changes are assumed to be linear:

$$M = M_0(1 + Az), \quad C_D = C_0(1 - Bz),$$

$$z \ll 0; A, B \ll 1$$

The approximate solution for fall rate as a function of depth is:

$$v \approx -V_T [1 + (A + B)z]^{\frac{1}{2}} \quad (2.2)$$

and

$$z \approx -V_T t + (A + B) V_T t^2 \quad (2.3)$$

These approximate solutions clearly show the dependence of v and z on the variable parameters. To first order in t the probe depth is determined by the nominal terminal speed [$V_T = (2M_0g/\rho_w C_0 S)^{\frac{1}{2}}$]. The coefficient of the quadratic term is also proportional to the relative changes in drag coefficient and mass ($A + B$). The empirical equations for probe depth as a function of time are typically quadratic, so we can compare the analytical results with empirical fits of observations.

Generally the effects of initial transient adjustment of the speed on the predicted depth cannot be obtained except by numerical integration of (2.1). Results of a numerical integration of with $v(z=0) = -15 \text{ m}\cdot\text{s}^{-1}$ are displayed in Fig. 1. The variations of A and B are less than the nominal values for an XCP (Table 4), but the shape of the curve is the same.

3. EXPERIMENTAL ANALYSIS

Present expendables, such as XBT's and XCP's, measure temperature - not depth or pressure. The probe depths can be inferred from equations giving fall time as a function of depth (pressure), but a more accurate method is based on a mapping of the temperature profile of an expendable on a temperature-pressure record obtained with a CTD in spatial and temporal proximity with the probe drop. In

XCP Fall Rate vs. Depth

$A = 0.000271$	$B = 0.000060$
$C_D = 0.350000$	$A_{\text{nom}} = 0.002113$
$M_0 = 0.633000$	$M_{\text{nom}} = 1.477000$
$V_0 = 15.00000$	$R_{\text{nom}} = 1825.0$

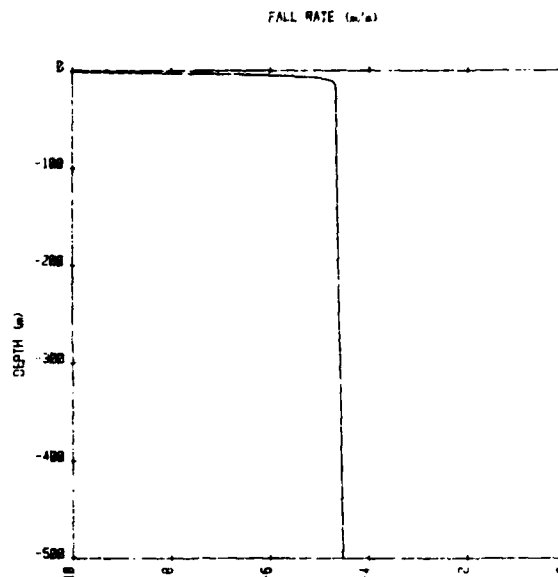


FIGURE 1

the experimental results presented here the CTD was lowered to 350 dbar; at this time the XCP was launched. The XCP passed the CTD before it reached 750 m depth. This method provided near-simultaneity.

The use of concurrent CTD casts, would, if required, make the profiler unsuitable for large scale rapid surveys. Thus, it is important to determine whether a suitable equation for pressure (or depth) as a function of time of drop can be obtained from a relatively small number of intercomparisons with concurrent CTD casts.

We are certainly not the first group to attempt this. Smart (private communication) has performed a similar study by comparing fall times with pressures, referencing both to specific features in the temperature profile. We have chosen to use as much of the temperature profile as possible with the object of reducing random errors.

The data set used for this study was obtained during the deployment cruise of the Acoustically Tracked Oceanographic Mooring (ATOM '79) project (Saunders, Green and Bergin, 1980). Concurrent CTD and XCP casts were made in a region of strong thermal and velocity

gradients in the central Gulf of Mexico in December, 1979. The thermal regime was characterized by a very uniform mixed layer underlain by a strong thermocline, rich in fine structure but belonging to a single water mass.

For each cast, an equation of pressure as a function of the time of drop was determined by fitting the 'observed' pressures and times to a function of the form.

$$p(t,N) = \sum_{n=0}^N a_n t^n \quad (3.1)$$

The fit is formally obtained by fitting the 'observed' pressures $P_0(t_0)$ to $p(t_0,N)$ where t_0 is the observed time and P_0 is the observed pressure from the CTD cast. These are related by the equations:

$$P_0 = P_0[T_0(\text{CTD})]$$

$$t_0 = t_0[T_0(\text{XCP})]$$

$$T_0(\text{CTD}) = T_0(\text{XCP}) + T_0(\text{offset})$$

It is easily understood, that this procedure will work only if $T_0(\text{CTD})$ and $T_0(\text{XCP})$ are monotonic functions of P_0 and t_0 , respectively. We were fortunate that there were large sections of the temperature profiles in all the casts analyzed where this requirement was satisfied. The mixed layer provided a convenient thermostat wherein the constant offsets between the XCP's and the CTD could be determined. A typical plot of interpolated pressure versus time, with both quantities referenced to the same temperature profile is presented in Figure 2.

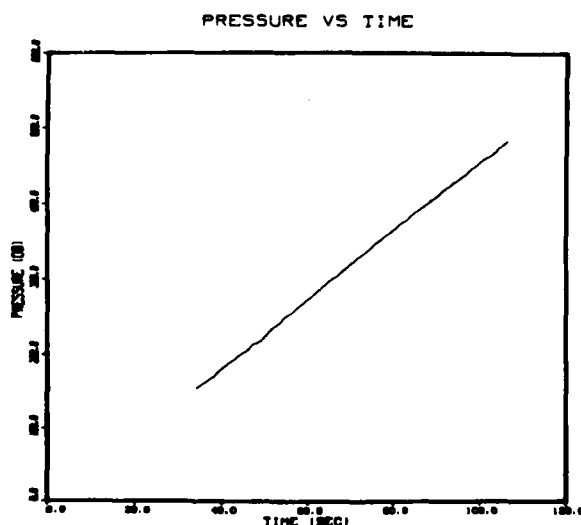


FIGURE 2

The results for the first order and second order fits are summarized in Tables 1 and 2 respectively. For both orders of fit, it is obvious that the initial offsets varied quite widely, while the fall rates appeared to vary in a narrow range.

This range may be associated to the 95% confidence limits computed using the Student's t-distribution with 24 degrees of freedom. These limits are denoted as $\mu_{+.05}$ and $\mu_{-.05}$ and have been computed for all the fitted coefficients. The nominal value for the linear term (using the quadratic formula), $4.544 \text{ dbar} \cdot \text{s}^{-1}$ is smaller than the lower confidence limit in Table 2, while the constant and quadratic terms, 3.1 dbar and $-6.75 \times 10^{-4} \text{ dbar} \cdot \text{s}^{-2}$, respectively, fall within the corresponding confidence limits and may be accepted.

Some values for the quadratically fitted coefficients, together with the associated parameters from the model equations are given in Table 3. For the original model, the constant term must be rejected at the 95% level, while the linear and quadratic terms cannot be rejected. After some experimentation with the model, it was found that an initial velocity of about 15 m s^{-1} produced acceptable coefficients.

It is highly unlikely that the probes ever entered the water at such high speeds, however. The probable cause for the large variation in the constant term is the method for establishing the zero time point (Sanford, private communication). This variation would, for small offsets, affect only the constant term in the pressure (depth)/time equation to a measurable degree.

When the empirical fits were made, the observed pressure was differentiated with respect to time and this derivative was plotted as a function of pressure. A typical example is shown in Figure 3. The large variation in the pressure-time derivative indicated to the possibility that the probe was precessing as it fell, causing an effectively changing drag coefficient. This was incorporated into the model as a drag coefficient, varying sinusoidally with depth. The magnitude of the variation of the drag coefficient turned out to be much too great if it were to account for the same order of the drop rate as was observed. This cursory test does not lay to rest the question of gyroscopic effects on probe dynamics, since it is conceivable that gyroscopic precession coupled with the surrounding flow could cause temperature anomalies and velocity errors. This is a subject for future work. We therefore advance the tentative hypothesis that the large apparent variations in the drop speed are artifacts of the XCP temperature trace and arise from the restricted flow past the XCP thermistor.

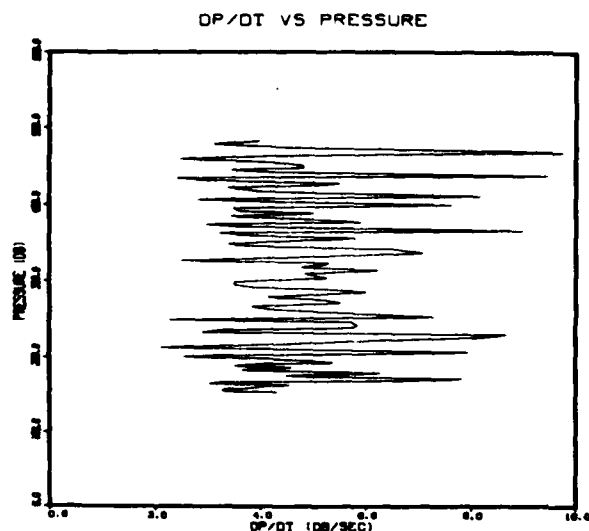


FIGURE 3

4. RECOMMENDATIONS

In view of the variations observed in the pressure time derivatives with depth and the large variation in the initial pressure offsets we make the following recommendations:

- a. a signal should be made available to inform the processor of the initial time of launch and surface impact;
- b. the thermistor should be mounted in a position (perhaps near the tail) where ventilation would be maximum. This would provide for better intercomparison with concurrent XBT or CTD drops;
- c. the initial probe mass (M_0) should be controlled during manufacture to within a 1% tolerance so that variations in fall speed due to mass variations can be reduced;
- d. gyroscopic effects on probe dynamics and measurements should be analyzed, if practicable;
- e. develop a new body shape nearer to ideal streamlined form with greater diameter to increase current sensitivity and better thermistor ventilation;
- f. a pressure signal should be multiplexed and sent up the signal wire.

5. REFERENCES

1. Green, A.W., 1981: Bulk Dynamics of the XBT (T-7), Submitted to Deep Sea Research.
2. Heinmiller, R.H., C.C. Ebbesmeyer, B.A. Taft, D.B. Olson and O.P. Nikitin, 1981: Intercomparisons of XBT and CTD isotherm depths in the Northwestern Atlantic, Submitted to Deep Sea Research.
3. Hoerner, S.F., 1965: Fluid Dynamic Drag, Hoerner Dynamics, Bricktown, New Jersey, U.S.A. 450 pp.
4. Saunders, K.D., A.W. Green, M.T. Bergin, 1981: A Comprehensive Graphical Representation of Data Obtained in the Acoustically Tracked Oceanographic Mooring (ATOM) Experiments, NORDA Technical Note 85, 621 pp.

TABLE 1. LINEAR FIT TO PRESSURE VS. TIME

XCP Cast	Q_0	Q_1	σ_p
4	5.65	4.63	0.40
8	9.60	4.63	1.43
9	7.18	4.54	2.27
11	11.88	4.61	2.23
12	15.03	4.51	2.97
13	6.44	4.57	0.87
14	12.77	4.42	2.80
15	4.66	4.58	0.59
16	38.10	4.66	1.14
17	4.19	4.50	1.22
18	4.52	4.51	1.25
20	5.02	4.53	1.62
21	-0.60	4.85	0.76
22	8.99	4.44	1.26
23	6.73	4.55	1.00
25	10.57	4.47	2.29
26	8.04	4.53	1.30
29	3.84	4.63	0.40
31	9.79	4.55	1.71
32	-4.28	4.58	1.66
34	11.27	4.69	2.81
35	8.03	4.64	1.79
36	12.29	4.63	2.46
37	5.00	4.57	0.89
38	7.99	4.61	1.55
M_0	8.504	4.576	
$\frac{M_0}{\rho}$	7.464	0.0883	
$\frac{M_0}{\rho} \frac{1}{H_0}$	3.145	0.0372	
M_0	11.649	4.613	
M_0	5.359	4.539	

TABLE 2. QUADRATIC FIT TO XCP PRESSURE VS. TIME

XCP Cast	Q ₀	Q ₁	Q ₂	σ_p
4	5.65	4.63	-0.141 x 10 ⁻⁵	0.40
8	7.29	4.71	-0.653 x 10 ⁻³	1.40
9	1.55	4.70	-0.891 x 10 ⁻³	1.93
11	11.26	4.63	-0.128 x 10 ⁻³	2.22
12	3.85	4.87	-0.235 x 10 ⁻²	2.02
13	3.93	4.65	-0.526 x 10 ⁻³	0.70
14	3.16	4.69	-0.150 x 10 ⁻²	1.79
15	2.19	4.68	-0.110 x 10 ⁻²	0.57
16	32.46	4.85	-0.124 x 10 ⁻²	0.62
17	-0.22	4.62	-0.714 x 10 ⁻³	1.24
18	-1.18	4.70	-0.134 x 10 ⁻²	1.09
20	-1.00	4.69	-0.837 x 10 ⁻³	1.20
21	-0.94	4.87	-0.228 x 10 ⁻³	0.76
22	2.85	4.60	-0.849 x 10 ⁻³	0.51
23	1.67	4.70	-0.883 x 10 ⁻³	0.63
25	6.30	4.58	-0.649 x 10 ⁻³	2.17
26	6.20	4.52	-0.313 x 10 ⁻³	1.26
29	6.38	4.68	+0.124 x 10 ⁻²	0.38
31	4.95	4.68	-0.758 x 10 ⁻³	1.36
32	-12.44	4.85	-0.194 x 10 ⁻²	1.47
34	1.21	4.96	-0.148 x 10 ⁻²	1.68
35	4.94	4.74	-0.638 x 10 ⁻³	1.71
36	3.55	4.88	-0.144 x 10 ⁻²	1.56
37	3.28	4.61	-0.399 x 10 ⁻³	0.85
38	2.03	4.79	-0.117 x 10 ⁻³	1.14

μ	3.956	4.708	-8.315 x 10 ⁻⁴
σ	7.323	0.115	7.042 x 10 ⁻⁴
$2.05 \sigma / \mu - 1$	3.085	0.0485	2.967 x 10 ⁻⁴
$\mu_{+0.5}$	7.041	4.76	-5.35 x 10 ⁻⁴
$\mu_{-0.5}$	0.871	4.66	-1.13 x 10 ⁻³

TABLE 3

A(10 ⁻⁵)	B(10 ⁻⁵)	C _D	v(z=0)	Q ₀	Q ₁	Q ₂ (10 ⁻³)
7.06	6.00	0.35	15	3.6625	4.7007	-0.979
	10.00			3.6772	4.6994	-1.169
	20.00			3.7283	4.6943	-1.613
	30.00			3.7963	4.6877	-2.017
	6.00		0	-2.353	4.7034	-0.979
			5	0.622	4.7022	-0.979
			10	2.387	4.7014	-0.979
		0.05		4.085	12.450	-6.863
		0.10		5.249	8.797	-3.425
		0.15		4.946	7.181	-2.282
		0.20		4.554	6.218	-1.711
		0.25		4.207	5.562	-1.370
		0.30		3.912	5.077	-1.141

TABLE 4. PHYSICAL CHARACTERISTICS OF XBT (T-7) AND XCP

	XBT(T-7)	XCP
Initial Probe Mass	0.740 kg	1.480 kg
Water Displacement	0.161 kg	0.650 kg
Initial Bulk Drag Coefficient	0.125 (Hoerner, 1965: torpedo)	0.35
Relative Mass Change (m ⁻¹ x10 ⁻⁵)	14.1	7.17
Relative Change of C _D (m ⁻¹ x10 ⁻⁴)	0.6	1.13
Nominal Fall Speed (m s ⁻¹)	6.5	4.7
Probe Length	0.215 m	0. m
Probe Cross Section Area (m ² x10 ⁻³)	2.11	2.

APPENDIX A
LIST OF SYMBOLS

A	(M ₀ - M)/(M ₀ 700 m), the relative change in probe mass
B	[C ₀ - C _D (700 m)]/C _D 700 m
C ₀	Initial drag coefficient of the probe after impact
C _D	The probe drag coefficient
g	Gravity acceleration 9.8 m s ⁻²
g'	g(1 - M _w /M ₀)
H	Probe range
M	Probe mass
M ₀	Probe mass at impact
M _w	Mass of displaced water
N	Order of the least squares polynomial fit
p	Pressure
P ₀	Observed CTD pressure
S	Cross section area of probe normal to axis of figure
Q _n	nth coefficient of least squares polynomial
T	Temperature
T ₀	Observed temperature
T ₀ (CTD)	Observed CTD temperatures
T(offset)	Computed temperature offset
T ₀ (XCP)	Observed XCP temperature
t	Time
v	Vertical speed
V _T	(2M ₀ g'/A _w C ₀ S) ^{1/2} , the nominal fall speed
z	Depth, z = 0
μ	Mean value
σ	Standard deviation

III. Summary Program Documentation

PROGRAM: XCP-FALL-RATE

PURPOSE: To compute emprical rates of XCP's based on simultaneous XCP and CTD temperature data

MACHINE: UNIVAC 1108

LANGUAGE: FORTRAN V

AUTHOR: Kim David Saunders

FILE LOCATIONS: Absolute, Relocatable and symbolic
Elements - CODE331*WORKFILE.MAIN/XCP

INPUT: Unit 8 - input FEB File - XCP data
Unit 9 - input FEB File - CTD data
Unit 5 -
line 1: ISEGX, ISEGY
line 2: PLIMX (1), PLIMX (2)
line 3: PLIMX (3)
line 4: ANS
line 5: IDEGREE

ISEGX - seg. no. for XCP cast on unit 8
ISEGC - seg. no. for CTD cast on unit 9
PLIMX (1) - upper pressure limit for computing temperature offset
PLIMX (2) - lower pressure limit for computing temperature offset
PLIMX (3) - starting pressure for T/P intercomparison
ANS - yes (for XCP temp. smoothing) no (for no smoothing)
IDEGREE - degree of fitting polynomial

OUTPUT: Unit 6 - Pressure limits (repeat of input)
 - Short FEB file headers
 - Averages of XCP and CTD temperatures
 - Temperature offset
 - NT, N2, T1, T2
 - Coefficients of best fit polynomial
 - Standard deviation of fit
 Unit 20 - Listings of pressures, temperatures and fall times
 Unit 25 - DISSPLA Plots

NT - Number of temperature points in input for
 interpolation
N2 - Number of points to be interpolated
T1 - Starting temperature
T2 - Ending temperature

SUBROUTINES CALLED: INITLZ

XCPRDR

CTDRDR

TMPOFS

TMPCOR

DPTCOM

PTINTP

TTINTP

FITTER

PLOTFR

INTRPL

<<DISPLA Package subroutines>>

ADDITIONAL
INFORMATION:

1. The XCP FEB File must have the form:
4 variables: P, T, U, V
2. The CTD FEB File must have the form:
8 variables, P, T, (other 6 are not used)
3. The maximum length of a segment is 1000 cycles
4. Each drop is stored in a separate segment, and the data should be interpolated to 1 decibar pressure surfaces, and low pass filtered with a cutoff of about 8 decibars. The filtering and interpolation may be done via ZFILT and ZINTERP. Both of these are standard FEB File utilities.

IV. Runstream to Create and Run the Program

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331

```
CODE331*WORKFILE(1).MAKER/XCP-CALIB
1  @USE W.CODE331*WORKFILE
2  @ASG.UP XCP-PR-2.F///2000
3  @FREE XCP-PR-2
4  @ASG.AX XCP-PR-2
5  @RRKPT PRINTS/XCP-PR-2
6  @HDG.P TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331
7  @PRT.S W.MAKER/XCP-CALIB
8  @PRT.S W.MAP/XCP-CALIB
9  @PRT.S W.RUN-1/XCP-CALIB
10 @ASG.T 20.F///2000
11 @ASG.UP 25.F///2000
12 @FREE 25
13 @ASG.AX 25.
14 @FRS 25.
15 @FRS 20.
16 @ASG.AX W.
17 @FOR.S W.MAIN/XCP-CALIB
18 @FOR.S W.INITL2/XCP-CALIB
19 @FOR.S W.XCPRRR/XCP-CALIB
20 @FOR.S W.CTDHDR/XCP-CALIB
21 @FOR.S W.TMPOFS/XCP-CALIB
22 @FOR.S W.TMPCOR/XCP-CALIB
23 @FOR.S W.OPTCON/XCP-CALIB
24 @FOR.S W.PTINTP/XCP-CALIB
25 @FOR.S W.TTINTP/XCP-CALIB
26 @FOR.S W.FITTER/XCP-CALIB
27 @FOR.S W.PLOTFR/XCP-CALIB
28 @FOR.S WISFILE.TNTRPL/ANIMA
29 @ADD.PL W.MAP/XCP-CALIB
30 @PACK W.
31 @PREP W.
32 @RRKPT PRINTS
33 @SYN.U XCP-PR-2.P4
34 @FREE XCP-PR-2
```

@PRT.S W.MAP/XCP-CALIB

V. Map Runstream

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331

```
CODE331*WORKFILE(1).MAP/XCP-CALIB
1  @MAP.IS W.XGT/XCP-CALIB
2  IN W.MAIN/XCP-CALIB..INITL2/XCP-CALIB..XCPRRR/XCP-CALIB
3  IN W.CTDHDR/XCP-CALIB
4  IN W.TMPOFS/XCP-CALIB..TMPCOR/XCP-CALIB..OPTCON/XCP-CALIB
5  IN W.PTINTP/XCP-CALIB..TTINTP/XCP-CALIB..FITTER/XCP-CALIB
6  IN W.PLOTFR/XCP-CALIB.CODF331*WDSFILE.2READ
7  IN CODF331*WDSFILE.TNTRPL/ANIMA
8  LIB DISPLA*LIBR-D.
```

@PRT.S W.RUN-1/XCP-CALIB

VI. Listing of a Typical Program Runstream with an Example of the Output to Unit 6

TEST RUN : XCP/CIC CALIBRATION PROGRAM - M D SAUNDERS - X4733 -NOPDA331

CODE331#WORKFILE(1).RUN-1/XCP-CALIB

```

1      #FREE 25
2      #ASG,UP XCP-25,F///2000
3      #FREE XCP-25
4      #USE 25,XCP-25
5      #ASG,AX 25
6      #ASG,TVJ IN1,U9V,5937
7      #ASG,T 9,F///2000
8      #ASG,T 8,F///2000
9      #MOVE IN1,U
10     #COPY,G IN1,9
11     #FREE,S IN1
12     #ASG,TVJ IN2,U9V,0639
13     #COPY IN2,8
14     #FREE IN2
15     #XOT W,XOT/XCP-CALIB
16     9.1
17     50,70
18     120
19     YES
20     1
21     #FREE 25

```

#ASG,T 20,F///2000
FACILITY WARNING 100000000000

#ASG,UP XCP-25,F///2000
FACILITY REJECTED 440000400000

#FREE XCP-25
FACILITY WARNING 100000000000

#ASG,AX XCP-25.
READY

#ERS XCP-25.
FURPUR27R3B E33 RL73R1 04/10/81 15:18:57
END ERS.

#USE 25,XCP-25
READY

#ERS 20.
FURPUR27R3B E33 RL73R1 04/10/81 15:19:00
END ERS.

#ASG,AX W.
FACILITY WARNING 102000000000

TEST RUN : XCP/CTD CALIBRATION PROGRAM - D SAUNDERS - X4733 -WORD4331

*ASG,TVJ IN1,U9V,5937
READY

*ASG,T 9,F///2000
FACILITY WARNING 100000070000

*ASG,T 8,F///2000
FACILITY WARNING 100000000000

*MOVE IN1,0
FURPUR27R38 E33 RL73R1 04/10/81 15:19:07

*COPY,6 IN1,9
CODE331*OUTF1(01) COPIED ON 06/11/80 AT 16:22:53 SPTUDS REFL-5937W
29 BLOCKS COPIED.
EOF ENCOUNTERED ON INPUT TAPE

*FREE,S IN1
READY

*ASG,TVJ IN2,U9V,0639
READY

*COPY IN2,8
FURPUR27R38 E33 RL73R1 04/10/81 15:20:52
838 BLOCKS COPIED.
EOF ENCOUNTERED ON INPUT TAPE

*FREE IN2
READY

*XUT W,XGT/XCP-CALIB
ENTER THE INPUT SEGMENTS FOR THE XCP AND CTD DATA IN FREE FORMAT

ENTER THE UPPER AND LOWER PRESSURE LIMITS FOR COMPUTING THE TEMPERATURE OFFSET

PLIMY(1) = 50.000000
PLIMY(2) = 70.000000

ENTER STARTING PRESSURE FOR T/P INTERCOMPARISON

R0 R 9V-SP 9 C 9 P70 4 15 15 80
DO YOU WANT SMOOTHING OF XCP TEMPERATURES ??

TEST RUN : XCP/CIP CALIBRATION PROGRAM - P D SAUNDERS - X4733 -NUPDA331

RU 9 70320 1 100000 491 F 40 40 100
TXAV = 25.411
TCAN = 25.473
T OFFSET = -0.1666-01

N1 = 377
N2 = 126
T1 = 24.500000
T2 = 11.700000

ENTER THE DEGREE OF FITTING POLYNOMIAL

I A(I)
1 5.239845
2 4.574780
STANDARD DEVIATION OF PRESSURE = .91083310

BEGIN OF DISPLA PLOT GENERATION.

PLOT NO. 1 WITH THE TITLE
DP/DT VS PRESSURES
HAS BEEN COMPLETED.

PLOT ID. READS
PLOT 1 15-20-45 FRI 10 APR, 1981 JOB=EUKOS , NAVOCEA DISSPLA VER H=0

DATA FOR PLOT

NO. OF CURVES DRAWN 1

HORIZ. AXIS LENGTH 7.0 INS.
VERT. AXIS LENGTH 9.0 INS.

HORIZ. ORIGIN .0000 VERT. ORIGIN .0000

HORIZ. AXIS LINEAR
STEP SIZE .1429*01 UNITS/INCH

TEST RUN : XCP/CID CALIBRATION PROGRAM - R D SAUNDERS - X4733 -MORDA331

VERT. AXIS LINEAR
STEP SIZE .6667*02 UNITS/INCH

.....
LOCATION OF CURRENT PHYSICAL ORIGIN .
X= 1.00 Y= .55 INCHES .
FROM LOWER LEFT CORNER OF PAGE .
.....

TEST RUN : XCP/CID CALIBRATION PROGRAM - R D SAUNDERS - X4733 -MORDA331

PLOTTING COMMENCING

..... DISSPLA VERSION 8.0
NO. OF FIRST PLOT 2

PLOT NO. 2 WITH THE TITLE
DP/DT VS PRESSURE - FILTERED
HAS BEEN COMPLETED.

PLOT ID. READS
PLOT 2 15.29.04 FRI 10 APR, 1981 JOB=EUNKS , NAVOCEA DISSPLA VER 8.0

DATA FOR PLOT

NO. OF CURVES DRAWN 1

HORIZ. AXIS LENGTH 7.0 INS.
VERT. AXIS LENGTH 9.0 INS.

HORIZ. ORIGIN .0000 VERT. ORIGIN .0000

HORIZ. AXIS LINEAR
STEP SIZE .1429*01 UNITS/INCH

VERT. AXIS LINEAR
STEP SIZE .6667*02 UNITS/INCH

.....
LOCATION OF CURRENT PHYSICAL ORIGIN .
X= 1.00 Y= .55 INCHES .
FROM LOWER LEFT CORNER OF PAGE .
.....

END DISSPLA -- 2030 VECTORS GENERATED IN 2 PLOT FRAMES.

OF
BEDF IGNORED - IN CONTROL MODE

VII. Program Listings

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331

CODE331*WORKFILE(1).MAIN/XCP-CALIB

1	CALL INITLZ	■ INITIALIZE PROGRAM
2	CALL XCPDRD	■ READ XCP DATA FROM FER FILE
3	CALL CTDRD	■ READ CTD DATA FROM FER FILE ON UNIT 9
4	CALL TMPDFS	■ CALCULATE TEMPERATURE OFFSET
5	CALL TMPCOR	■ CORRECT XCP TEMPERATURES
6	CALL OPTCOM	■ SELECT COMMON DEPTH INTERVAL
7	CALL PTINTP	■ INTERPOLATE PRESSURE ON TEMPERATURE
8	CALL TTINTP	■ INTERPOLATE TIME ON TEMPERATURE
9	CALL FITTER	■ FIT THE PRESSURE/TIME CURVE
10	CALL PLOTFR	■ PLOT THE PRESSURE/TIME CURVE
11	STOP	
12	END	

APRT.5-M.INITLZ/XCP-CALIB

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331

CODE331#WORKFILE(1)-INITL7/XCP-CALIB

```

1      SUBROUTINE INITL7
2      C
3      C
4      C
5      C
6      C   PURPOSE : TO INITIALIZE THE XCP CALIBRATION PROGRAM
7      C
8      C
9      C
10     C
11     COMMON /DIAGS/ IDIAG(10)
12     COMMON /RDATA/ VR(10000)
13     COMMON /RDOC1/ TDOCR(100)
14     COMMON /RDOCF/ FDOCR(100)
15     COMMON /RDOCA/ ADOCR(100)
16     COMMON /RHDR/ IRHDR(100)
17     COMMON /RLOCK1/ TIMEX(1000),TX(1000),PX(1000),TC(1000),PC(1000)
18     COMMON /RLOCK2/ PLIMX(10),PLIMC(10),TSE6C,TSE6X,TOSFT
19     COMMON /RLOCK3/ TEMP(1000),P(1000),TIME(1000)
20     SEAL BUFFER(10,1000)
21     EQUIVALENCE (VR(1),BUFFER(1,1))
22     WRITE(6,100)
23     READ(5,200) TSE6X,TSE6C
24     100  FORMAT(' ENTER THE INPUT SEGMENTS FOR THE ' ,
25           1  'XCP AND CTD DATA IN FREE FORMAT'//)
26     200  FORMAT(1)
27     2000  WRITE(6,101)
28     READ(5,200) PLIMX(1),PLIMX(2)
29     WRITE(6,103) PLIMX(1),PLIMX(2)
30     103  FORMAT(' PLIMX(1) = ',670.8/' PLIMX(2) = ',620.8//)
31     IF ( PLIMX(1).LT.PLIMX(2) ) GO TO 1000
32     IF ( PLIMX(1) .EQ. PLIMX(2) ) GO TO 2000
33     P = PLIMX(1)
34     PLIMX(1)=PLIMX(2)
35     PLIMX(2)= P
36     1000  CONTINUE
37     PLIMC(1) = PLIMX(1)
38     PLIMC(2) = PLIMX(2)
39     101  FORMAT(' ENTER THE UPPER AND LOWER PRESSURE LIMITS FOR ' ,
40           1  'COMPUTING THE TEMPERATURE OFFSET'//)
41     WRITE(6,102)
42     READ(5,200) PLIMX(3)
43     PLIMC(3)=PLIMX(3)
44     102  FORMAT(' ENTER STARTING PRESSURE FOR T/P INTERCOMPARISON'//)
45     RETURN
46     END

```

APRT.S M.XCPDRR/XCP-CALIB

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NOR0A331

CODE331*WORKFILE(1),XCPDRD/XCP-CALIF

1 SUBROUTINE XCPDRD

2 C

3 C

4 C

5 C

6 C PURPOSE : TO READ IN XCP DATA FROM LOGICAL UNIT 6 INTO THE 1

7 C MAIN BUFFER ARRAY AND TRANSFER THE DATA TO THE 1

8 C PRESSURE AND TEMPERATURE ARRAYS. TO COMPUTE THE XCP 1

9 C TIME ARRAY FROM THE PRESSURE ARRAY, USING THE 1

10 C INVERSE OF TOM SANFORD'S ALGORITHM. 1

11 C

12 C

13 C

14 C

15 COMMON /DIAGS/ IDIAG(10)

16 COMMON /RDATA/ VR(10000)

17 COMMON /RDOCI/ IDOER(100)

18 COMMON /RDOCF/ FDOCF(100)

19 COMMON /RDOEA/ ADOER(100)

20 COMMON /RHDR/ IRHDR(100)

21 COMMON /BLOCK1/ TIMEX(1000),TX(1000),PX(1000),TC(1000),PC(1000)

22 COMMON /BLOCK2/ PLIMX(10),PLINC(10),ISFGC,ISEGX,TOFSFT

23 COMMON /BLOCK3/ TEMPL(1000),P(1000),TIME(1000)

24 COMMON /BLOCK7/ YES,ANS

25 REAL BUFFER(4,1000),A,B,C,TXX(1000)

26 INTEGER YES,ANS

27 EQUIVALENCE (VR(1),BUFFER(1,1)),(VR(1001),TX(1))

28 YFS = 6HYES

29 IDIAG(1) = 1

30 IDIAG(2) = 1

31 IDIAG(3) = 1000

32 IDIAG(4) = 1000

33 IDIAG(5) = 10

34 IDIAG(6) = 40

35 IDIAG(7) = 40

36 IDIAG(8) = 100

37 IDIAG(9) = 1

38 IDIAG(10) = 1

39 DATA C,D,A/3,1,4,544,0.0006749/

40 C

41 C

42 C

43 C CLEAR THE BUFFER

44 C

45 C

46 C

47 DO 999 I = 1,10000

48 VR(I) = 0

49 999 CONTINUE

50 DO 998 I = 1,1000

51 PX(I) = 0

52 TX(I) = 0

53 TEMPL(I) = 0

54 998 CONTINUE

55 C

56 C

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X9733 -NORDA331

```

57 C-----
58 C      LOAD IN THE XCP DATA
59 C-----
60 C-----
61 C
62 C      CALL ZRFADIA,IF,ISFCN)
63 C      DO 1000 I = 1,1000
64 C      IPX = BUFFER(1,I)
65 C      IF(IPX .GT. 1000 .OR. IPX .LT. 1) GO TO 1000
66 C      PX(IPX) = BUFFER(1,I)
67 C      TX(IPX) = BUFFER(2,I)
68 C      TIMEX(IPX) = 4.5 * SORT(RAD - 4 * A * (C - IPX)) / (2 * A)
69 1000 CONTINUE
70 C-----
71 C-----
72 C-----
73 C-----
74 C SMOOTH XCP TEMPERATURES IF DESIRED
75 C-----
76 C-----
77 C-----
78 C-----
79 C      WRITE(6,100)
80 C      READ(5,101) ANS
81 100  FORMAT(' DO YOU WANT SMOOTHING OF XCP TEMPERATURES ??'//)
82 101  FORMAT(1A6)
83 C      IF(ANS .NE. YES) RETURN
84 C      DO 1001 I = 3,998
85 C      TXX(I) = .25 * (TX(I+1) + TX(I-1)) + 0.7 * (TX(I+2) + TX(I-2)) + 0.3 * TX(I)
86 1001 CONTINUE
87 C      DO 1002 I = 3,998
88 C      TX(I) = TXX(I) / 1.2
89 1002 CONTINUE
90 C      RETURN
91 C      END

```

APRT.S W.C.TDRNR/XCP-CALIB

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -W0RDA331

CODE331=WORKFILE(1),CTDRDR/XCP-CALIP

```

1      SUBROUTINE CTDRDR
2      C
3      C
4      C
5      C
6      C PURPOSE : TO READ IN CTD DATA FROM LOGICAL UNIT 8 INTO THE
7      C             MAIN BUFFER ARRAY AND TRANSFER THE DATA TO THE
8      C             PRESSURE AND TEMPERATURE ARRAYS. TO COMPUTE THE XCP
9      C             TIME ARRAY FROM THE PRESSURE ARRAY, USING THE
10     C             INVERSE OF TOM SANFORD'S ALGORITHM.
11     C
12     C
13     C
14     C
15     COMMON /DIAGS/ IDIAG(10)
16     COMMON /RDATA/ VR(10000)
17     COMMON /RDOC1/ IDOCR(100)
18     COMMON /RDOC2/ FDOCR(100)
19     COMMON /RDOCA/ ADDCR(100)
20     COMMON /RHDR/ IRHDR(100)
21     COMMON /PLOCK1/ TIMEX(1000),TX(1000),PX(1000),TC(1000),PC(1000)
22     COMMON /PLOCK2/ PLIMX(10),PLIMC(10),ISEGC,ISEGX,TOFSFT
23     COMMON /PLOCK3/ TEMPL(1000),P(1000),TIMEF(1000)
24     COMMON /PLOCK7/YES,ANS
25     INTEGER YES,ANS
26     REAL BUFFER(8,1000),TCX(1000)
27     REAL BUF(10,1000)
28     EQUIVALENCE (VR(1),BUF(1,1)),(VR(1000),TCX(1))
29     EQUIVALENCE (VR(1),BUFFER(1,1)),(VR(1000),TCX(1))
30     IDIAG(1) = 1
31     IDIAG(2) = 1
32     IDIAG(3) = 1000
33     IDIAG(5) = 10
34     IDIAG(6) = 100
35     IDIAG(7) = 100
36     IDIAG(8) = 100
37     IDIAG(9) = 1
38     IDIAG(10) = 1
39     C
40     C
41     C
42     C CLEAR THE BUFFER *****
43     C
44     C
45     DO 999 I = 1,10000
46         VR(I) = 0
47     999     CONTINUE
48     DO 998 I = 1,1000
49         PC(I) = 0
50         TC(I) = 0
51     998     CONTINUE
52     C
53     C
54     C
55     C LOAD IN THE CTD DATA *****
56     C

```

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K O SAUNDERS - X4733 -NORDA331

```

57      C
58      C
59      CALL ZREAD(9,IF,ISFGC)
60      IF (IRHDR(1).NE.0 .AND. IRHDR(1).NE.10) GOTO 9999
61      DO 1000 I = 1,1000
62          IF (IRHDR(1).NE.0) GOTO 2000
63          IPC = BUFFER(1,I) + .4999
64          IF (IPC.LT.1 .OR. IPC.GT.1000) GOTO 1000
65          PC(IPC) = BUFFER(1,I)
66          TC(IPC) = BUFFER(2,I)
67      2000      CONTINUE
68          IF (IRHDR(1).NE.10) GOTO 2010
69          IPC = BUFFER(1,I) + .4999
70          IF (IPC.LT.1 .OR. IPC.GT.1000) GOTO 1000
71          PC(IPC) = BUFFER(1,I)
72          TC(IPC) = BUFFER(2,I)
73      2010      CONTINUE
74      1000      CONTINUE
75      IF (ANS .NE. YES) RETURN
76      DO 1001 I = 3,999
77          TC(I) = .25*(TC(I+1)+TC(I-1))+0.2*(TC(I+2)+TC(I-2))+0.3*TC(I)
78      1001      CONTINUE
79      DO 1002 I = 3,999
80          TC(I) = (TC(I)+TC(I+1))/1.2
81      1002      CONTINUE
82      RETURN
83      9999      WRITE(6,10)
84      10      FORMAT('ERROR IN FER FILE STRUCTURE - TERMINATING')
85      STOP
86      END

```

APR15 11.10PM OFS/XCP-CALIB

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331

CODE331*WORKFILE(1).TMP0FS/XCP-CALIF

```

1      SUBROUTINE TMP0FS
2      C
3      C
4      C
5      C
6      C PURPOSE : THIS SUBROUTINE COMPUTES THE AVERAGE OFFSET TEMPERATURE
7      C             OVER A GIVEN ASSUMED DEPTH RANGE + OBTAINED IN INIT(2)
8      C             FOR CORRECTING THE XCP TEMPERATURES.
9      C             TOFSF = AVERAGE(TCTD - TXCP)
10     C
11     C
12     C
13     C
14     COMMON /DIAGS/ IDIAG(10)
15     COMMON /RDATA/ VR(10000)
16     COMMON /RDOCI/ IDOCP(100)
17     COMMON /RDOFF/ FDOCR(100)
18     COMMON /RDOCA/ ADOCR(100)
19     COMMON /RHDR/ IRHDR(100)
20     COMMON /BLOCK1/ TIMEX(1000),TX(1000),PX(1000),TC(1000),PC(1000)
21     COMMON /BLOCK2/ PLINX(10),PLTMC(10),TSEGC,TSEGN,TOFSF
22     COMMON /BLOCK3/ TEMP(1000),P(1000),TIME(1000)
23     REAL BUFFER(10,1000)
24     EQUIVALENCE (VR(1),BUFFER(1,1))
25     REAL TXAV,TCAV
26     C
27     C
28     TXAV = 0
29     TCAV = 0
30     N = 0
31     I1 = PLINX(1)
32     I2 = PLINX(2)
33     DO 1000 J = I1,I2
34         TXAV = TXAV + TX(I)
35         TCAV = TCAV + TC(I)
36         N = N + 1
37     1000 CONTINUE
38     TXAV = TXAV/N
39     TCAV = TCAV/N
40     TOFSF = TXAV - TCAV
41     WRITE(6,100) TXAV,TCAV,TOFSF
42     100 FORMAT(' TXAV =',G16.5/' TCAV =',G16.5/
43     ' TOFSF =',G16.5//)
44     RETURN
45     END

```

BPRT.5 V.TMPC06/XCP-CALIF

TEST RUN : XCP/CTD CALIPRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331

CODE331*WORKFILE(1).TMPCOR/XCP-CALIP

```

1  SUBROUTINE TMPCOR
2  COMMON /DIAGS/ IDIAG(10)
3  COMMON /RDATA/ VR(10000)
4  COMMON /RDOC1/ IDOCR(100)
5  COMMON /RDOCF/ FDOCR(100)
6  COMMON /RDOCA/ ADOCR(100)
7  COMMON /RMDR/ IRMDR(100)
8  COMMON /RLOCK1/ TIMEX(1000),TX(1000),PX(1000),TC(1000),PC(1000)
9  COMMON /RLOCK2/ PLIMX(10),PLIME(10),TSF6C,TSF6X,TOFSET
10 COMMON /RLOCK3/ TFMP(1000),P(1000),TIME(1000)
11 REAL BUFFER(10,1000)
12 EQUIVALENCE (VR(1),BUFFER(1,1))
13 DO 1000 I = 1,1000
14   IF (TC(I) .EQ. 0 .OR. TX(I) .EQ. 0) GO TO 1000
15   TX(I) = TX(I) - TOFSET
16   1000 CONTINUE
17   RETURN
18   END

```

~~APRT.5 U.DPTCOM/XCP-CALIP~~

TEST RUN : XCP/CTD CALIPRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331

CODE331*WORKFILE(1).DPTCOM/XCP-CALIP

```

1  SUBROUTINE DPTCOM
2  COMMON /DIAGS/ IDIAG(10)
3  COMMON /RDATA/ VR(10000)
4  COMMON /RDOC1/ IDOCR(100)
5  COMMON /RDOCF/ FDOCR(100)
6  COMMON /RDOCA/ ADOCR(100)
7  COMMON /RMDR/ IRMDR(100)
8  COMMON /RLOCK1/ TIMEX(1000),TX(1000),PX(1000),TC(1000),PC(1000)
9  COMMON /RLOCK2/ PLIMX(10),PLIME(10),TSF6C,TSF6X,TOFSET
10 COMMON /RLOCK3/ TFMP(1000),P(1000),TIME(1000)
11 REAL BUFFER(10,1000)
12 EQUIVALENCE (VR(1),BUFFER(1,1))
13 I1 = PLIMX(1) + 0.001
14 I2 = 11
15 DO 1000 I = 1,1000
16   IF (TX(I-1) .LE. TX(I) .OR. TC(I-1) .LE. TC(I)) GO TO 1001
17   IF (TX(I) .EQ. 0 .OR. TC(I) .EQ. 0) GO TO 1001
18   I2 = I2 + 1
19   1000 CONTINUE
20   1001 PLIMX(4) = I2-6
21   RETURN
22   END

```

~~APRT.5 U.DPTINTP/XCP-CALIP~~

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331

CODE331#WORKFILE(1).PTINTP/XCP-CALIB

```

1      SUBROUTINE PTINTP
2      COMMON /DIAGS/ IDIAG(10)
3      COMMON /RDATA/ VR(10000)
4      COMMON /RDOC1/ INOCR(100)
5      COMMON /RDOC2/ FDOCR(100)
6      COMMON /RDOCA/ ADOCR(100)
7      COMMON /RHDR/ IRHDR(100)
8      COMMON /BLOCK1/ TIME1(1000),TX(1000),PX(1000),TC(1000),PC(1000)
9      COMMON /BLOCK2/ PLTMX(100),PTIME(100),TSF6C(100),TSF6X(100),TSF6Y(100)
10     COMMON /BLOCK3/ TEMP(1000),P(1000),TIME(1000)
11     COMMON /BLOCK4/TEMP2(1000),P2(1000),TIME2(1000)
12     COMMON /BLOCK5/T1,T2,DT,NT,N2
13     REAL BUFFER(10,1000)
14     EQUIVALENCE (VR(1),BUFFER(1,1))
15     DT = 0.1
16     I1 = PLTMX(1) + 0.001
17     I2 = PLTMX(10) + 0.001
18     T1 = TX(I1)
19     T2 = TX(I2)
20     IF (T1 .GT. TC(I1)) T1 = TC(I1)
21     IF (T2 .GT. TC(I2)) T2 = TC(I2)
22     IT1 = 10*T1 - 0.5
23     IT2 = 10*T2 + 0.5
24     TI = IT1/10.
25     T2 = IT2/10.
26     DO 1000 I = 1,12
27     TI = TI - TI + 1
28     TJ = I2 - TI + 1
29     TEMP(IJ) = TC(IJ)
30     P(IJ) = PC(IJ)
31     1000 CONTINUE
32     NT = I2 - I1 + 1
33     N2 = 0
34     DO 1001 I = 1,1000
35     N2 = N2 + 1
36     TEMP2(N2) = T2 + DT*(I-1)
37     IF (TEMP2(N2) .GE. T1) GOTO 1002
38     1001 CONTINUE
39     N2 = N2 - 1
40     1002 I = 1,1000
41     P2(I) = 0
42     1003 CONTINUE
43     CALL INTERPL(6,NT,TEMP,P,N2,TEMP2,P2)
44     RETURN
45     END

```

APRT.S W.TTINTP/XCP-CALIB

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331

CODE331*WORKFILE(1).TTINTP/XCP-CALIF

```

1      SUBROUTINE TTINTP
2      COMMON /DIAGS/ IDIAG(10)
3      COMMON /RDATA/ VR(10000)
4      COMMON /RDOC1/ IDOCR(100)
5      COMMON /RDOCF/ FDOCR(100)
6      COMMON /RDOCA/ ADOCR(100)
7      COMMON /RMDR/ IRMDR(100)
8      COMMON /RLOCK1/ TIMEX(1000),TX(1000),PX(1000),TC(1000),PC(1000)
9      COMMON /RLOCK2/ PLIMX(10),PLIME(10),ISEG6,ISEG8,TOF5F1
10     COMMON /RLOCK3/ TEMP(1000),P(1000),TIME(1000)
11     COMMON /RLOCK4/TEMP2(1000),P2(1000),TIME2(1000)
12     COMMON /RLOCK5/ T1,T2,DT,NT,N2
13     REAL BUFFER(10,1000)
14     EQUIVALENCE (VR(1),BUFFER(1,1))
15     I1 = PLIMX(1) + 0.001
16     I2 = PLIMX(4) + 0.001
17     DO 1000 I = 1,I2
18         I1 = I - I1 + 1
19         I2 = I2 - I1 + 1
20         TEMP(I1) = TX(I1)
21         TIME(I1) = TIMEX(I1)
22     1000 CONTINUE
23     CALL INTERPL6(NT,TEMP,TIME,N2,TEMP2,TIME2)
24     WRITE(6,300)NT,N2,T1,T2
25     300 FORMAT(//, '*****'/
26     1, ' * NT = ',I5,' * N2 = ',I5,' * T1 = ',G20.8,' * T2 = ',G20.8//)
27     WRITE(20,100)
28     DO 1002 I = 1,1000
29     1002 WRITE(20,200)I,PX(I),TX(I),TIMEX(I),PC(I),TC(I)
30     1002 CONTINUE
31     100 FORMAT(1H, ' * DISPLAY OF ARRAYS PX,TX,TIMEX,PC,TC'//)
32     200 FORMAT(5X,I5,'G20.8)
33     C
34     C
35     WRITE(20,99)
36     DO 1001 I = 1,1000
37     1001 WRITE(20,100) I,TEMP2(I),P2(I),TIME2(I)
38     1001 CONTINUE
39     99 FORMAT(1H, ' * DISPLAY OF ARRAYS TEMP2,P2,TIME2'//)
40     100 FORMAT(5X,I5,'G20.8)
41     RETURN
42     END

```

APR15 0.5 U.F. FILTER/NEP-CALIF

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NORDA333

```

CODE331*WORKFILE(1).FITTER/XCP-CALIB
1      SUBROUTINE FITTER
2      COMMON /DIAGS/ IDIAG(10)
3      COMMON /RDATA/ VR(10000)
4      COMMON /RDOC1/ IDOCR(1000)
5      COMMON /RDOC2/ FDOC(1000)
6      COMMON /RDOCA/ ADOCR(1000)
7      COMMON /RMBR/ RMBR(1000)
8      COMMON /BLOCK1/ TIME1(1000),TX(1000),PX(1000),TC(1000),PC(1000)
9      COMMON /BLOCK2/ PLTIME(100),PLINC(100),ISEG(100),ISEG1(100),ISEG2(100)
10     COMMON /BLOCK3/ TEMP(1000),P(1000),TIME(1000)
11     COMMON /BLOCK4/ TEMP2(1000),P2(1000),TIME2(1000)
12     COMMON /BLOCK5/ T1,T2,DT,NT,N2
13     REAL A(1000),COEF(1000),TIT1(1000),TIT2(1000),TIT3(1000)
14     REAL ALPHA(1000),BETA(1000),W(1000)
15     EQUIVALENCE (VR(1),ALPHA(1)),(VR(100),BETA(1)),(VR(200),
16     1 TIT1(1)),
17     1 (VR(300),TIT2(1)),(VR(400),TIT3(1)),(VR(500),A(1)),
18     1 (VR(600),COEF(1)),(VR(700),W(1))
19     GO 1000 IF = 1.0000
20     W(1) = 1.0
21     1000 CONTINUE
22     C
23     C
24     900 WRITE(6,300)
25     READ(5,301)END=9991 K
26     IF (K .EQ. 0 .OR. K .GT. 9) RETURN
27     IF (K .LT. 0) K = 1
28     300 FORMAT(' ENTER THE DEGREE OF FITTING POLYNOMIAL'//)
29     301 FORMAT(1)
30     CALL ORTHLS(TIME2,P2,W,N2,0.0,COEF,ALPHA,BETA,K,TIT1,
31     TIT2,TIT3,IND1)
32     CALL COEFS(0,COEF,ALPHA,BETA,K,A,TIT1,TIT2,TIT3,IND2)
33     N1 = K + 1
34     WRITE(6,99)
35     GO 1001 IF = 1,K1
36     WRITE(6,100) I,A(1)
37     1001 CONTINUE
38     ERROR = 0
39     GO 2000 IF = 1,N2
40     PP = 0
41     X = TIME2(1)
42     DO 2001 J = 1,K1
43     PP = PP + A(J)*X**(J-1)
44     2001 CONTINUE
45     ERROR = ERROR + (P2(1)-PP)**2
46     2000 CONTINUE
47     ERROR = ERROR/N2
48     ERROR = SQRT(ERROR)
49     WRITE(6,200) ERROR
50     200 FORMAT(' STANDARD DEVIATION OF PRESSURE = ',620,A//)
51     99 FORMAT(1X,11,15X,1A111//)
52     100 FORMAT(5X,13,10X,615.7)
53     GO TO 900
54     999 RETURN
55     END

```

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -W0DA331
 DPRT,S W.PLOTFR/XCP-CALIB

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -W0DA331

CODE331*WORKFILE(1).PLOTFR/XCP-CALIB

```

1      SUBROUTINE PLOTFR
2      COMMON /DIAGS/ IDIAG(10)
3      COMMON /RDATA/ VR(10000)
4      COMMON /RDOC1/ IDOCR(100)
5      COMMON /RDOCF/ FDOCR(100)
6      COMMON /RDOCA/ ADOCR(100)
7      COMMON /RMDR/ IRMDR(100)
8      COMMON /BLOCK1/ TIME1(1000),TX(1000),PX(1000),TC(1000),PC(1000)
9      COMMON /BLOCK2/ PLTIME(10),PLTMC(10),TSEGE,TSEGN,TFSST
10     COMMON /BLOCK3/ TEMP(1000),P(1000),TIME(1000)
11     COMMON /BLOCK4/ TFWP2(1000),P2(1000),TIME2(1000)
12     COMMON /BLOCK5/ T1,T2,DT,NT,N2
13     REAL W(1000),PW(1000),WW(1000),TT(1000)
14     EQUIVALENCE (W(1),V(1)),(PW(1),VR(1001)),(WW(1),VR(2001))
15     EQUIVALENCE (TT(1),VR(3001))
16     C
17     C
18     C
19     C
20     C
21     C --- COMPUTE FALL SPEEDS AND ASSOCIATED PRESSURES ---
22     C
23     C
24     C
25     C
26     DO 1000 I = 2,N2
27     J = N2 - I + 2
28     W(I) = (P2(J) - P2(J-1)) / (TIME2(J) - TIME2(J-1))
29     PW(I) = (P2(J) + P2(J-1)) / 2.
30     TT(I) = TIME2(J)
31     1000    CONTINUE
32     C
33     C
34     C
35     C
36     C --- PLOT THE PRESSURE TIME DERIVATIVE AS A FUNCTION
37     C --- OF PRESSURE ---
38     C
39     C
40     C
41     C
42     N1 = N2 - 1
43     CALL COMPRS
44     CALL TITF('DP/DT VS PRESSURE',100,'DP/DT (GN/SEC)',100,
45     'PRESSURE (GN)',100,7,0,0)
46     CALL GRAF(0,2,10,0,100,600)
47     CALL FRAME
48     CALL CROSS
49     CALL CURVE(W(2),PW(2),N1,N)
50     CALL ENDPL(1)
51     WRITE(20,500)
52     DO 5000 I = 1,N2
53     WRITE(20,501) I,W(I),PW(I)
54     5000    CONTINUE
55     DO 6000 I = 2,N2
56     WW(I) = 0.25*(W(I-1) + W(I+1)) + 0.5*W(I)

```


TEST RUN : XCP/CTD CALIBRATION PROGRAM - M D SAUNDERS - X9733 -NORDA331

```

57      6000      CONTINUE
58          CALL RGNPL(2)
59          CALL TITLE('DP/DI VS PRESSURE - FILTEREDS',100,
60      ----- 1 ----- 'DP/DI (MM/SEC)',100,
61      1          'PRESSURE (DB)%',100,7,9.)
62          CALL GRAF(0,2,10,0,100,600,1)
63          CALL FRAME
64          CALL CROSS
65          CALL CURVE(W(2),PW(2),N1,0)
66      ----- CALL FNDPL(2) -----
67          CALL RGNPL(3)
68          CALL TITLE('PRESSURE VS TIME',100,
69      1          'TIME (SEC)',100,
70      1          'PRESSURE (DB)%',100,7,9.)
71          CALL GRAF(0,20,120,0,100,600,1)
72      ----- CALL FRAME -----
73          CALL CROSS
74          CALL CURVE(TT(2),PW(2),N1,0)
75          CALL FNDPL(3)
76          CALL DONEPL
77          WRITE(20,500)
78      ----- NO 5010 I = 1,N? -----
79          WRITE(20,501) I,W(I),TT(I),PW(I)
80      5010      CONTINUE
81      501      FORMAT(1H1,' LISTING OF ARRAYS W(I) , TT(I), PW(I) *///)
82      501      FORMAT(5X,15,3620,P)
83          RETURN
84      ----- END -----

```

APRT.S KDSFILE.INTRPL/AKIMA

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331

CODE331*MODSFILE(1).INTRPL/ANIMA

```

1      SUBROUTINE INTRPL(IU,L,X,Y,N,U,V)
2      C      INTERPOLATION OF A SINGLE VALUED FUNCTION
3      C      *****
4      C      THIS SUBROUTINE INTERPOLATES, FROM VALUES OF THE FUNCTION
5      C      GIVEN A ORDINATES OF INPUT DATA POINTS IN THE X-Y PLANE
6      C      AND FOR A GIVEN SET OF X-VALUES(ABCTSSAS), THE VALUES OF
7      C      A SINGLE VALUED FUNCTION Y=Y(X).
8      C      *****
9      C
10     C      THIS ALGORITHM WAS PUBLISHED IN COMM. ACM. 15(10)OCT 1972
11     C      WRITTEN BY HIROSHI ANIMA,U.S. DEPT OF COMMERCE,OFFICE OF
12     C      TELECOMMUNICATIONS.
13     C      INSTITUTE OF TELECOMMUNICATIONS SCIENCES, BOULDER COLO
14     C      *****
15     C
16     C      THE INPUT PARAMETERS ARE
17     C
18     C          IU = LOGICAL UNIT NUMBER OF STANDARD OUTPUT UNIT
19     C          L  = NUMBER OF INPUT DATA POINTS
20     C          X  = ARRAY OF DIMENSION L STORING THE X VALUES
21     C          (ABCTSSAS) OF THE DATA POINTS IN ASCENDING ORDER
22     C          Y  = ARRAY OF DIMENSION L STORING THE Y VALUES
23     C          (ORDINATES) OF THE INPUT DATA POINTS
24     C          N  = NUMBER OF POINTS AT WHICH INTERPOLATION OF THE
25     C          Y VALUES (ORDINATES) IS DESIRED
26     C          U  = ARRAY OF DIMENSION N STORING THE X VALUES OF THE
27     C          DESIRED POINTS.
28     C
29     C      OUTPUT PARAMETERS
30     C          V  = ARRAY OF DIMENSION N WHERE THE INTERPOLATED Y
31     C          VALUES ARE STORED
32     C      *****
33     C
34     C      DECLARATION STATEMENTS
35     C
36     C      DIMENSION X(L),Y(L),U(N),V(N)
37     C      EQUIVALENCE (IU,X3),(OU,V3),(O1,T3)
38     C      REAL M1,M2,M3,M4,M5
39     C      EQUIVALENCE (IU,X3),(IUN,X2,A1,M3),(IUN,X5,A5,M5),
40     C          (J,SU,S1),(Y2,U2,U4,O2),(Y5,U3,O3)
41     C
42     C      *****
43     C      PRELIMINARY PROCESSING
44     C      *****
45     C      LN=L
46     C      LM1=LN-1
47     C      LM2=LM1-1
48     C      LP1=LN+1
49     C      MD=M
50     C      IF ( LM2 .LT. 0 )      GO TO 90
51     C      IF ( MD .IF. 0 )      GO TO 91
52     C      DO 11 J=2,LN
53     C          IF (X(1-1)-X(J))      11,95,96
54     C      CONTINUE
55     C      IPV = 0
56     C

```

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331

```

57      C      *****
58      C      ***** MAIN DO LOOP *****
59      C      *****
60      C      DO 80 N = 1,N0
61      C      UNCU(N)
62      C
63      C
64      C      ROUTINE TO LOCATE DESIRED POINT
65      C
66      C
67      20      IF (LM2 .EQ. 0) GO TO 27
68      C      IF (UM .GT. X(10)) GO TO 26
69      C      IF (UM .LT. X(1)) GO TO 25
70      C      IMN=2
71      C      IMX = 10
72      C      I = (IMN+IMX)/2
73      C      IF (UM .GT. X(I)) GO TO 23
74      22      IMX = I
75      C      GO TO 24
76      23      IMN = I + 1
77      24      IF (IMX .GT. IMN) GO TO 21
78      C      I = IMX
79      C      GO TO 30
80      25      I=1
81      C      GO TO 30
82      26      I = 10
83      C      GO TO 30
84      27      I=2
85      C
86      C
87      C      CHECK IF I = IPV
88      C
89      C
90      30      IF (I .EQ. IPV) GO TO 70
91      C      IPV = I
92      C
93      C
94      C      ROUTINES TO PICK UP NECESSARY X AND Y
95      C      VALUES AND TO ESTIMATE THEM IF NECESSARY
96      C
97      C
98      40      J=1
99      C      IF (J .EQ. 1) J=2
100      C      IF (J .EQ. 10) J=10
101      C      X3=X(J-1)
102      C      Y3=Y(J-1)
103      C      X4=X(J)
104      C      Y4=Y(J)
105      C      A3=X4-X3
106      C      M3=(Y4-Y3)/A3
107      C      IF (LM2 .EQ. 0) GO TO 43
108      C      IF (J .GT. 2) GO TO 41
109      C      X2=X(J-2)
110      C      Y2=Y(J-2)
111      C      A2=X3-X2
112      C      M2=(Y3-Y2)/A2
113      C      IF (J .EQ. 10) GO TO 42

```

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331

```

114      41      X5=X(J+1)
115      Y5=Y(J+1)
116      A4=Y5-X4
117      M4=(Y5-Y4)/A4
118      IF(IJ.EQ.2) M2=M3 + M3 - M4
119      GO TO 45
120      42      M4=M3+M3-M2
121      GO TO 45
122      43      M2 = M3
123      45      IF(IJ.LE.3) GO TO 46
124      A1=Y2-X1J-31
125      M1=(Y2-Y1J-31)/A1
126      GO TO 47
127      46      M1=M2+M2-M3
128      47      IF(IJ.GE.LH1) GO TO 48
129      A5 = X1J+2) - Y5
130      M5 = (Y1J+2) - Y5)/A5
131      GO TO 50
132      48      M5=M4+M4-M3
133      C
134      C
135      C      NUMERICAL DIFFERENTIATION
136      C
137      C
138      50      IF(1.EQ.LP1) GO TO 52
139      W2=ARS(M4-M3)
140      W3=ARS(M2-M1)
141      SW=W2+W3
142      IF(SW.NE.0.0) GO TO 51
143      W2=0.5
144      W3=0.5
145      SW=1.0
146      51      T3=(W2+M2+W3+M3)/SW
147      IF(IJ.EQ.1) GO TO 54
148      52      W3=ARS(M5-M4)
149      W4=ARS(M3-M2)
150      SW=W3+W4
151      IF(SW.NE.0.0) GO TO 53
152      W3 = 0.5
153      W4 = 0.5
154      SW = 1.0
155      53      T4=(W3+M3+W4+M4)/SW
156      IF(IJ.NF.LP1) GO TO 60
157      T3 = T4
158      SA = A2 + A3
159      T4 = 0.5*(M4+M5-A2+(A2-A3)*(M2-M3)/(SA+SA))
160      X3 = X4
161      Y3 = Y4
162      A3 = A2
163      M3 = M4
164      GO TO 60
165      54      T4=T3
166      SA=A3+A4
167      T3=0.5*(M1+M2-A4+(A3-A4)*(M3-M4)/(SA+SA))
168      X3 = X3 - A4
169      Y3 = Y3 - M2+A4
170      A3 = A4

```

TEST RUN : XCP/CTD CALIBRATION PROGRAM - K D SAUNDERS - X4733 -NORDA331

```

171          M3 = M2
172      C
173      C
174      C      DETERMINATION OF THE COEFFICIENTS
175      C
176      C
177      60      U7=(2.0*(M3-T4)+M3 - T4)/A3
178      63=(M3-M3+T3+T4)/A3+0.33
179      C
180      C
181      C      COMPUTATION OF THE POLYNOMIAL
182      C
183      C
184      70      UX=UX-P0
185      80      V(K)=00+DX*(01+DX*(02+DX*03))
186      RETURN
187      C
188      C
189      C      ERROR EXITS
190      C
191      C
192      90      WRITE(IU,2090)
193      GO TO 99
194      91      WRITE(IU,2091)
195      GO TO 99
196      95      WRITE(IU,2095)
197      GO TO 97
198      96      WRITE(IU,2096)
199      97      WRITE(IU,2097) I,X(I)
200      99      WRITE(IU,2099) L,N,N0
201      RETURN
202      2090      FORMAT(1X,' *** L = 1 OR LESS **')
203      2091      FORMAT(1X,' *** N = 0 OR LESS **')
204      2095      FORMAT(1X,' *** IDENTICAL X VALUES **')
205      2096      FORMAT(1X,' *** X VALUES OUT OF SEQUENCE **')
206      2097      FORMAT(1X,' I=*,17.10X,*N**')
207      2099      FORMAT(1X,' I=*,17.10X,*N =*,17/')
208      *IX,'***ERROR DETECTED IN ROUTINE INTRPL*****')
209      END

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